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Introduction

The Genesis of the Book

During January and June 1999, thousands of scientists and policymakers from over one hundred fifty countries gathered in Anaheim, California, and Budapest, Hungary, to examine the complex roles and interrelations of science, ethics, policy, environment, and technology for the twenty-first century.

These two end-of-the-century summits, which in combination comprised the largest, most diverse gatherings of scientists in history, were sponsored by the AAAS (American Academy for the Advancement of Science), UNESCO (United Nations Educational, Scientific, and Cultural Organization) and ICSU (International Council for Science).

Filmmakers Gill Wright, Teun Timmers, and Michael Tobias had been commissioned by UNESCO—with the support of the AAAS and ICSU—to film a multipart documentary series for television incorporating filmed interviews from these two important gatherings. Three documentary teams from the United States, the United Kingdom, and Hungary in all captured over sixty in-depth thirty- to ninety-minute sit-down discussions with individual scientists, the interviews conducted by Tobias and Timmers. In addition, major addresses were also filmed, as well as dozens of shorter "stand-up" interviews with other visiting scientific delegates, and an in-depth roundtable discussion with nearly twenty younger scientists from around the world.

The Style of the Book

Great thinkers are not always, of course, the best speakers or writers. In the case of these chosen scientists, participants have been selected on the basis of three qualities: their intellectual stature, their diversity of commitments, and their facilities for expression. The resulting styles have meant the accommodation of a wide range. Great ideas, brought forth under the "pressure" of live cameras,

engendering a degree of candor that is highly unusual; a forthrightness that can claim no fallback to more studied, abstract methods of conveyance.

The book provides accessible platforms of open discussion and contemplation. The interview questions have been delegated to topic headings, as it were; deleted in practice to ensure a smoother, more compact, and readable presentation.

The subject matter ranges from North/South economics and the scientific brain drain; to biodiversity; sustainability; politics; cloning; life and death ethics; medicine in the twenty-first century; high-energy physics; the Big Bang; United States, European, and broad African science policies; the fate of the Earth; the role of education, the plight of women in the sciences; the role of lending agencies like the World Bank; communication in science; the ozone hole; the rain forests; coral ecology; the relationship between industry and science; AIDS; indigenous folklore as a form of critical watershed science; global warming; ethics and technology; sustainability and agriculture; evolutionary paleontology; animal rights; and prospects for human settlement on Mars.

Interviewees come from the United States, Israel, Ireland, the United Kingdom, Sweden, India, Hungary, Sudan, France, Spain, Brazil, Cuba, Canada, Denmark, Germany, Egypt, and Belgium.

The book serves as a fine guide to the issues and nuances of twenty-first century scientific thought. These are not "prepared" pieces for an anthology but a lively, often iconoclastic dialogue that is distinguished by its frankness and willingness to tackle hard questions; and by the power of the media to elicit a style of delivery that can be assimilated by readers of many ages and disciplines.

As such, the work should prove fascinating to all students of social, natural, and "hard" sciences; to teachers, parents, and those interested in public policy, futurism, and ethics. It is a rich overview of the state of the scientific world; its obsessions, fears, ghosts, and high ambitions. Nearly all of the pieces devolve, at some point, to the speaker's own personal life; her or his hopes, dreams, and enthusiasm. In this regard, *A Parliament of Science* is an important window on the roots of scientific discovery; what it is that compels individuals to embark on a career in science; what specific questions trigger scientific investigation, as opposed to some other avenue of discovery.

With its ethical focus throughout, and with the raising of hard questions that scientists, policy makers, and the public must address, *A Parliament of Science* is no simple celebration of the works of science but, rather, a sobering reappraisal of where we've been, what our ingenuity has wrought for better or worse, and where we and the whole planet seem to be headed. To contextualize science in this arena is new—given the range of interviewees—and should prove to be a great stimulus to added thought and discussions.

Historical Context

The ethical root of so much of the foregoing raises an historical perspective worth commenting upon here. Francis Bacon, Viscount St. Albans (1561–1626), is often credited with having been the first philosopher of science as presented in his work *Advancement of Learning.* But where Bacon failed to account for the disposition of facts, or for the ability of scientists to discriminate among the useful ideas of their peers and predecessors, was with regard to the whole arena of judgment. In Latin *scientia* (knowledge) connotes no other responsibility or moral calling. It is, strictly, the realm of facts, without obligation, application, or duty. Indeed, Bacon's own greatest work of science, *Novum Organum* (The New Instrument), was composed in Latin, a language known by only a minute coterie of the public. It thus confirmed a long-standing bias in favor of "experts," precluding the "common man" from gaining access to that realm of divine knowledge (read: divine grace). Knowledge has always been tantamount to power and privilege, both domains of which—in any society—imply relations between people that must—at the risk of great peril or prejudice—be moderated. Hence, from the time of Aristotle, there was no way to separate science from politics or ethics.

Bacon was conflicted over this dichotomy that pitted the real world, with its many tumbles and all too human nature, against the pure sphere of the fact. His proposals for scientific method laid the groundworks for an irreconcilability: Ethics and moral judgment beside the direct observation of nature with its Platonic Forms. From these two realms must necessarily come a perfect synthesis. But it scarcely exists.

A thousand years ago, it existed with even less likelihood than in Bacon's Renaissance days. On the momentous eve of a new millennium, A.D. 999, Gerbert de Aurillac, Pope Sylvester II, one of the most learned people in papal history, had to balance the fears of the multitudes across Europe—the battle between the biblical Gog and Magog, the Apocalypse, and Armageddon—with his far more sober, scientific learning. Sylvester had memorized Aristotle, Cicero, Porphyry, and Boethius. Taught poetry and logic, and mathematics and astronomy. Loved literature. Musician, author, philosopher, this uncommon Pope dispensed with most Biblical commentary and built his own globes to recreate the known planets; fashioned a sundial, and tinkered assiduously with an abacus. His library was grand. Imagine, then, his dilemma, upon being thought of as the mouthpiece for God, a possibly compromising, if embarrassing situation to begin with for a man of science; then having to weigh the future of the world, while tens of thousands of fearful, unlettered denizens of Rome stood all night in St. Peter's Square waiting for some divine embrace. Was redemption possible in a world of doubt? The

stakes were ultimate. One man of science, wearing the highest robes of the Vatican, against the unknown.

Pope Sylvester chose wisely, cautioning his minions to fear not, to have faith. A very politically savvy strategy. Humanity saw the world carry on the day after, business more or less as usual. But consider what science was, in Sylvester's age: Arabic alchemy, only the first hint of the notion of a chemical laboratory, the "zero" only recently introduced to computational analysis, astrology still passing for astronomy in most people's minds, no clue about oxygen, and—except for the rare Avicenna or Rhazes (generalists with groundbreaking ideas about physiology and pharmacology)—the practice of medicine was more primitive than in Greek times, fourteen hundred years earlier, and life expectancy still hovered around thirty-two years, as it had during the time of Christ.

By the period of Francis Bacon, much had changed, but much had not. There had been remarkable strides in lens crafting, allowing unprecedented views into the galaxy, and into the insides of living organisms. Medicine, while still barbaric by even yesterday's standards, had, at least, replaced alchemy. In Japan the first anesthetics were coming into being. Astrology was gone. Earth sciences were competing with Biblical conceptions. Mineralogy, physics, chemistry, and logical reasoning had combined in their emphasis to engender a veritable vocation of science. The language adopted by its practitioners would have been understood by today's specialists. However, this "renaissance," properly hailed, did little to ameliorate the turmoils of economic, political, and medical life that pervaded the entire human population, whether in the wilds of Florida, New Mexico, or Brazil, or in the capitals of the Commonwealth, Europe, and Asia. Nor did scientists view themselves as agents of cultural interference. There was no link, as yet, between theory and practice, understanding and responsibility, and insight and stewardship. The priestly caste of deep knowledge was, by the very criteria of disinterested objectivity that science had emulated, removed from all these tiring vicissitudes of human civilization.

Yet, Voltaire would speak of that "consolation to the human spirit for the calamities which it will experience in all ages," and he was referring to "philosophy" that he—like Newton whom he greatly admired—considered synonymous with "science" and "scientist." What commiserations? Knowledge itself? Or some other practical domain whereby the fruits of scientific inquiry might trickle down to ease the burden of an existential reality?

By the late nineteenth century, science had begun to embrace its powerful roles, transforming countless discoveries into a policy, a patent, an application, or a profit, where possible. This is to cast no cynical bent to the remarkable history of research, or to knowledge for the sake of knowledge, but to recognize the evolving dependencies between science, government, and industry that arose in the context of complex geopolitical machinations and in the turbulent

destinies of over a billion people (the global population at the time of Karl Marx). By the period of relativity, quantum physics, and—most emphatically, World War II—science had become a power unprecedented in the history of human capacity; a new force to rival all others in the puzzle of warring nations and aspiring societies. But whether for Pope Sylvester II, Francis Bacon, or Albert Einstein, the perilous minefield was the same: The fate of knowledge, the fate of the world, and the role of the human heart.

The Present Context and the Twenty-first Century

There was a time, not too long ago, as one of our contributors points out, when the newly described "atom" was more or less a joke in some quarters; a perceived fancy of little likely concern to anybody, ever. Similar scorn would be levied in their day upon electricity, oil, the automobile, even the shopping cart, and—more recently, with echoes still resonating—the personal computer. Even the fuel cell, that ingenious combination of technologies that powered us to the Moon, and back, and now enjoys a status as a likely cornerstone of the alternative energy revolution, witnessed in the aftermath of the Apollo program, a lapse of interest for nearly two crucial decades. Similarly, there were whole centuries when Aristotle was ignored, in particular, his knowledge of biology and intuitive grasp of ecological interdependency. He also recognized the hazards of human overpopulation. His revival in much later centuries coincided with the first stirrings of biodiversity loss; a recognition by some that forests were disappearing, cities becoming polluted, and water fouled. Plato, too, had warned of environmental disruption, citing the destruction of Mediterranean watersheds. Today, Plato and Aristotle are seen to have been philosophers and scientists deeply concerned not merely about Ideal Forms, or Republics, but about real problems in their time. Problems all too with us.

Now, no one takes lightly the revolution in knowledge and technology, the advances and critical importance of all the sciences, and their collective, indeed—urgent—relevancy to the twenty-first century. Hence, the two gatherings of scientists at Anaheim and Budapest—nearly six thousand of them—and the co-attendance by policy experts, corporate leaders, politicians, students, and journalists from all over the world.

The goals of these two august assemblages were many, perhaps overly ambitious as they needed to be. But foremost among their concerns were five consistently articulated points: (1) the need of scientists to listen to one another, and to state their cases clearly and compellingly to the public, to other educators, and to policy makers; (2) the importance that nonscientists pay attention; (3) the inextricable relationship between science and ethics; (4) the ecological crisis that is very real and that must necessarily require the coordinated efforts

of nearly all scientists, policy makers, and the public to turn it around in time; and (5) the fact that science has the expertise, the tools, and methodologies—but only if granted the priority, the economic preconditions by governments—to help make this a better world for all.

Each of these imperatives ring loud and clear in the interviews presented in *A Parliament of Science.* Consider Robert Watson describing the struggle to turn the desperate insights of global climate science into workable policies to wake up government and industry with their vested political and economic interests. Or Anthony C. Janetos and Robert May conveying the alarming particulars of a whole new wave—possibly the sixth spasm, so-called—of planetary extinctions, a "peppering of small holocausts" across Earth.

Others, like Rita R. Colwell and Nobel Laureate Leon M. Lederman, speak to the sheer joy of science, and its importance to civilization, as well as to their own personal lives. They each make powerful arguments for an enhanced appreciation of science education, as well as for theoretical research. In the case of Lederman, it was the invisible neutrino that early on absorbed his research; for Colwell, the equally omnipresent and curious bacteria. Other contributors, like Frans B. M. de Waal and Nobel Laureate Joseph Rotblat, have devoted their research to peace. To understanding the mechanisms by which other primates make peace; and to challenging our too easy assumptions and habitual patterns of conflict. Rotblat's voice haunted all those present at the Budapest conference, exerting an unforgettable injunction and putting on notice, in essence, the human race: Make peace, not war; make certain that science is in no way perverted by those who would sooner turn to hatred, division, and killing, than to nurturance, love, and empathy.

In holding science to the highest levels of accountability, Margaret Somerville challenges us to rethink cloning and bioengineering. She writes,

> We have to find some way that we can all personally identify with life; relate to life; and through which we can personally, and as communities, find this sense of deep respect for life that we are prepared to maintain. Out of that comes probably the most important ethical question that we will ask: What should we not do that we now can do?

In other approaches to the debate, M. S. Swaminathan and Ismail Serageldin bring a deep empathy for widespread suffering to the table. How can we minimize pain in this world? The question involves not merely science, and ethics and spirituality, but the most practical considerations for dealing with inequities in global agricultural, health, and human resources. Can cloning be applied in ways that will unanimously serve humanity without violating inalienable human and other animal rights, exacerbating existing social fears and differences, or infringing on the fragile web of biological habitat? And how

might traditional wisdom provide additional insights to such questions and dilemmas? Indian ecologist Madhav Gadgil looks at ancient customs and cultural contributions still being made in his native land that suggest additional and often crucial contexts for even framing the debates that engage science.

The debate about global warming is less divisive, more universally acknowledged, but no less troublesome in its implications or confounding resolution. The awesome truth of human overpopulation factors into nearly every prospect of the future, only heightening the confusing array of priorities, and investing each and every one of us with a mission to do our best, in return.

Science, in the end, can not dictate policies of sustainability. Only NGIs—non-governmental individuals, their communities, and elected leaders can collectively do so. It can, according to Ismail Serageldin, feed those eight hundred million who are hungry, and those billions of people without electricity or proper sanitation or clean water, health care, or education. And it must, according to the general chorus of voices throughout *A Parliament of Science* act responsibly to conserve the earth, cherish all life, and pass on a legacy all future generations can live with.

In the end, it is hope in humanity itself around which science must rally. Says Federico Mayor, the Director General of UNESCO at the time of the Anaheim and Budapest conferences, "Human beings are the eyes of the Universe, and these eyes that know what is happening and that design their own future, that is our hope." For Mohammed H. A. Hassan, President of the African Academy of Sciences, this hope is lodged in his own family. He refers to his two daughters, like so many thousands of other young African students, for whom it is his ardent wish that they manage to return home and find the way to utilize their evolving knowledge base "to help foster an African renaissance." For author, professor, and former ambassador Crispin Tickell, his hope is not only grounded in the next generation, but he also looks to the adults of today who "have got to admit," he argues, "that the world in which they were born and in which they are now growing up has got a lot of things wrong with it." Tickell is particularly concerned about humanity's ability to steward and shepherd an interdependent world, one in which life itself has utterly shaped the planet we all must share.

Because so much of science is focused upon life itself, it is not surprising that the scientists who speak out in this volume are all deeply concerned with the future of life on earth. Yechiel Becker, professor of molecular virology at Hebrew University in Jerusalem, considers how science and scientists might intervene to create mechanisms for peace, whether in the Middle East, against bioterrorism, and in regional conflicts everywhere. Similarly, John Durant explains how the public's perceptions of science, and its anxieties about such currents as genetic modification, need to be addressed by scientists who are willing to interact with the public and to make their enterprise accessible and

comprehensible. In addition, says Durant, scientists have to take more responsibility for what it is they do, and the power they wield.

This interaction with the public, argues Julia Marton-Lefèvre, is crucial to solving problems. If human behavior needs to change in order to compensate for problems our species alone has inflicted, scientists—who are often in the front trenches of analyzing those problems—must work in partnership with the public.

Ultimately, science will go nowhere if it can not adequately embrace all people. Bruce Alberts, president of the National Academy of Sciences in Washington, D.C., believes that this can only happen when scientists are prepared to share their knowledge with peoples of all nations. To ask questions and seek answers that will be not only of theoretical importance, but useful for people in need, while providing incentives and inspiration to one generation after another of new students who can thrill to the mysteries of the world and find in science multiple avenues all open to them. "Every child [is] a scientist," says Alberts, speaking of new science curricula that provide hands-on experiences; and that give children, in particular, new ways to think, and new and exciting opportunities for becoming effective citizens of the twenty-first century.